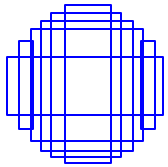


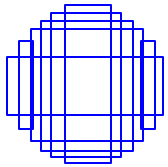
Technology Service Corporation

Surveillance Sensor Coverage for the Airspace Management System Improvement Program (AMSIP)

Presented at the
NASA I-CNS Conference, 2 May 2002

By Leonard A. Carlson
Technology Service Corporation (TSC)

(Presentation to include selected slides from this package)



Technology Service Corporation

Introduction

This presentation addresses a software tool, ***The Radar Support System (RSS)*,*** recently used for surveillance sensor coverage and performance analysis on the NAWCAD Airspace Management System Improvement Program (AMSIP). The presentation includes:

- RSS description
- Results of the AMSIP application
- Other application examples

Also referred to as the Computer Aided Siting System (COMPASS**)*

Technology Service Corporation

RSS Functions

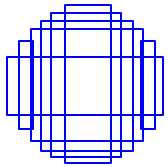
- Determines optimum sensor location/height based on environment and sensor parameters
- Evaluates performance of the sensor including effects of terrain, buildings, etc.
- Evaluates impact of proposed construction on existing sensor performance
- Identifies causes of existing sensor performance problems
- Produces numerous performance plots – Probability of detection, line of sight, beacon false targets, ….

The RSS automates sensor siting previously done with scaffolding, cherry picker, binoculars, etc.

Technology Service Corporation

RSS Applications

- Air Traffic Management (ATM) radar including airport surface, terminal and en-route
- Other ATM sensors including multilateration, multiple radar networks, etc.
- Air Defense System (ADS) radar
- Harbor surveillance radar
- Perimeter security surveillance sensors including radar, FLIR, LLLTV, etc.
- Artillery fire control radar – related product called the FireFinder Position Analysis System (FFPAS)
- Control towers and other visual applications



Technology Service Corporation

RSS Operation

- Model the site/region of interest
  - Terrain elevation
  - Terrain cover (provides clutter information)
  - Cultural features
- Model the sensor characteristics
- Exercise the sensor within the modeled environment to predict performance

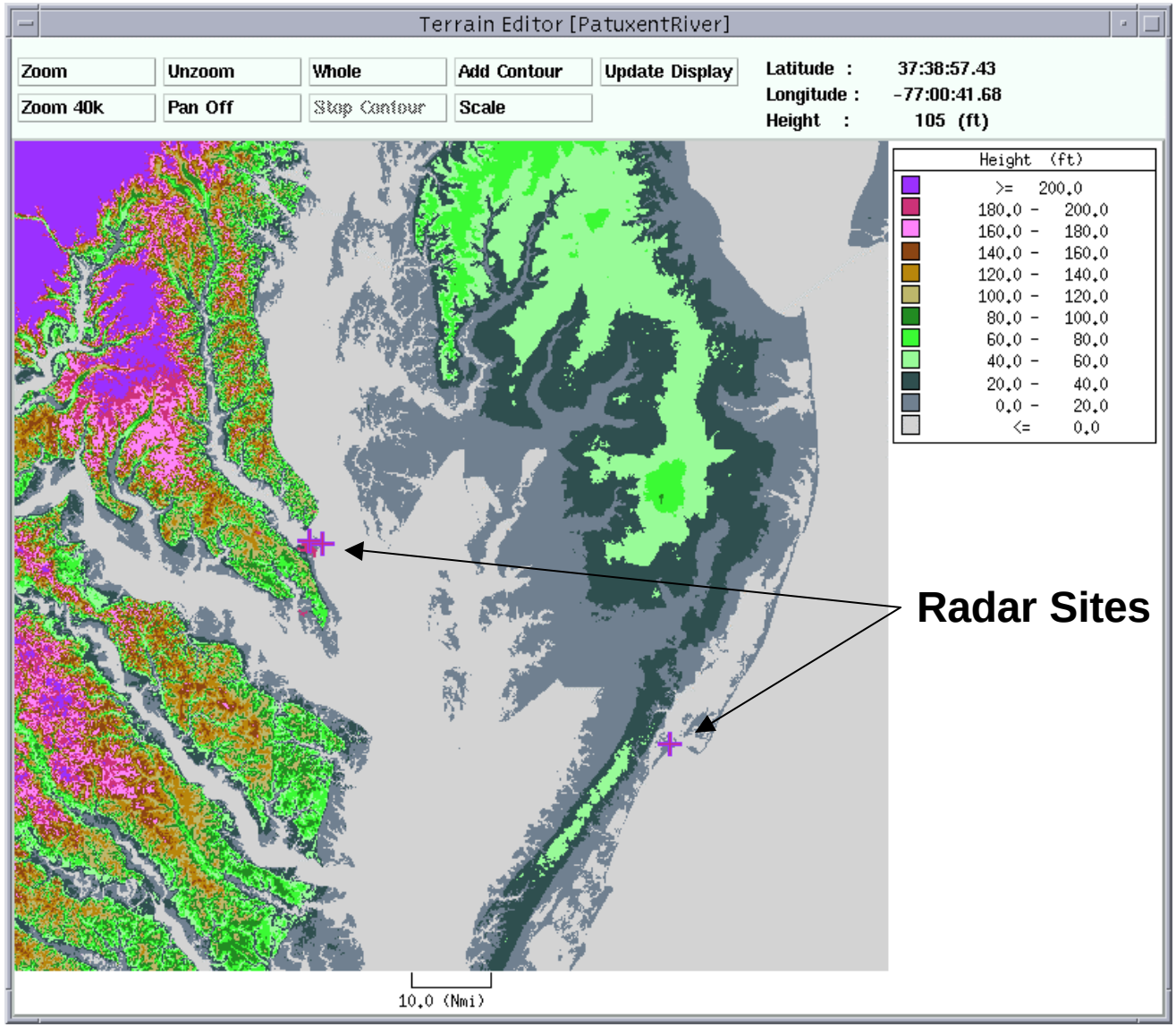
Technology Service Corporation

AMSIP Siting Overview

- AMSIP addresses the airspace around the Naval Air Warfare Center Aircraft Division (NAWCAD), Pax River
- Initial siting addressed 3 radar systems
  - ASR-11 at NAWCAD Pax River
  - ASR-8 at Wallops Island
  - SPS-67 at NAWCAD Pax River Ships Ground Station
- ASR-11 & ASR-8 are ATM radars
- SPS-67 is a shipboard surface search radar that will serve dual purpose as an ATM gap filler

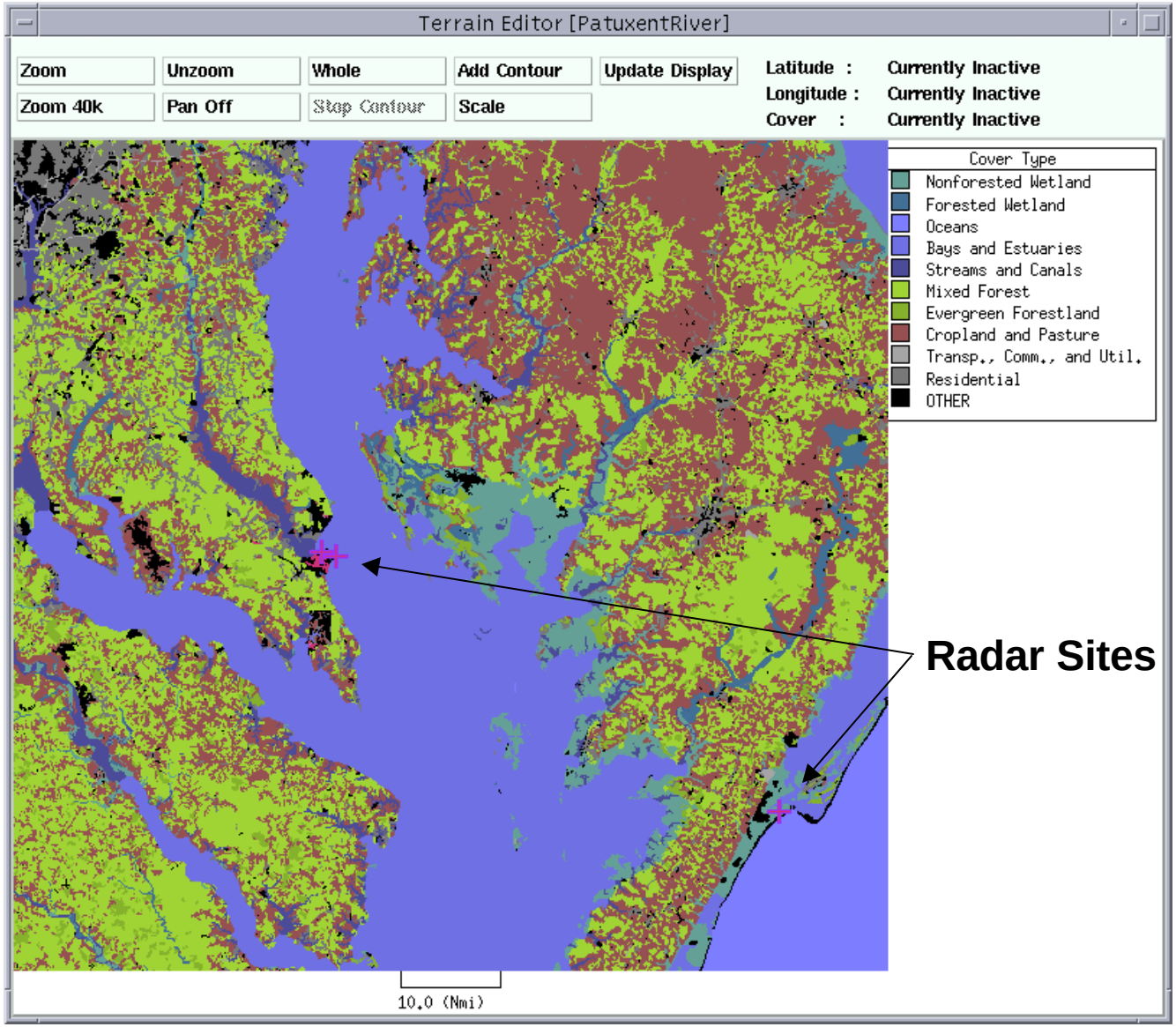
Technology Service Corporation

Pax And Wallops Terrain Elevation Data



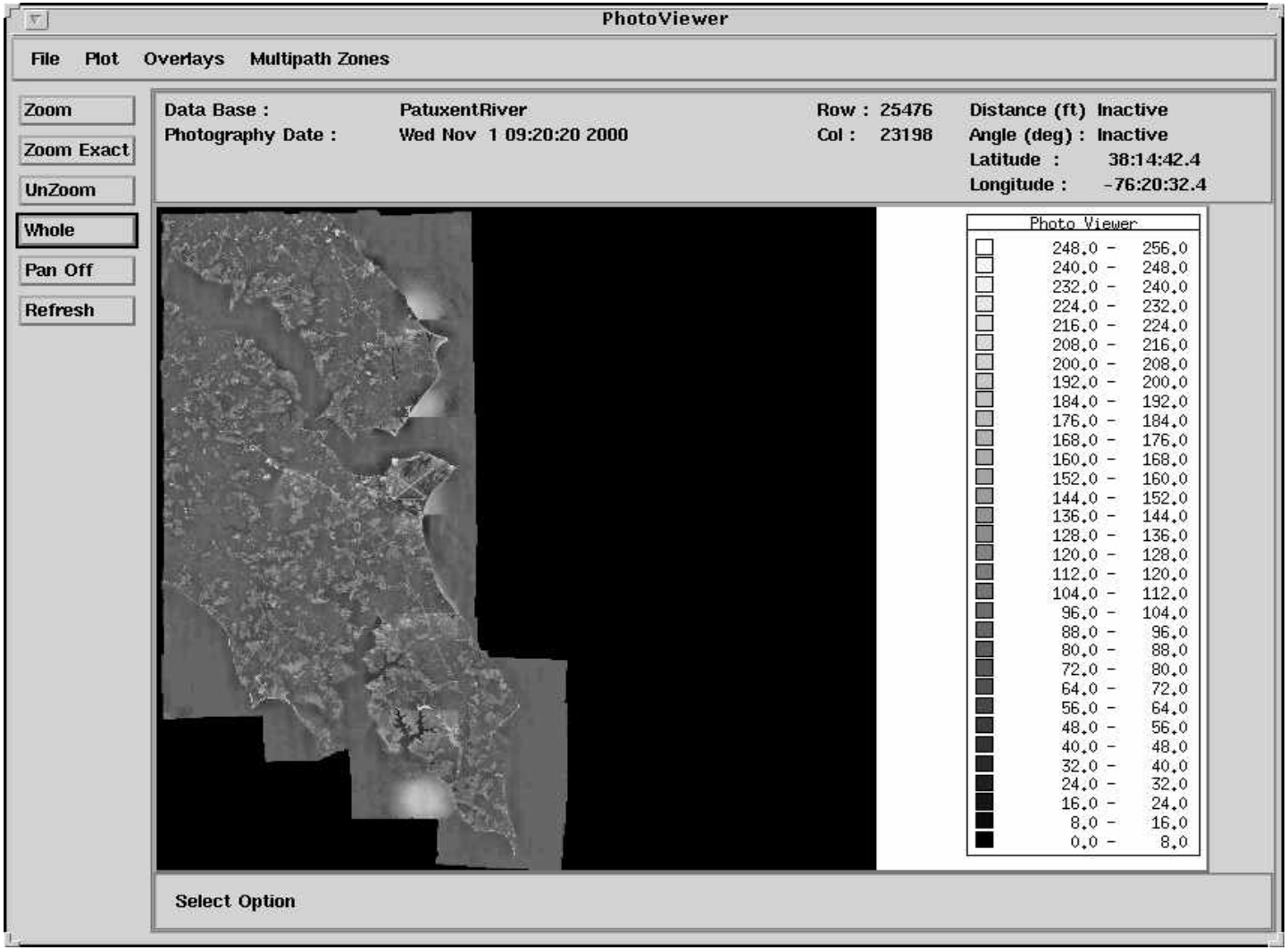
Technology Service Corporation

Pax and Wallops Terrain Cover Data



Technology Service Corporation

Photography Used To Generate Pax Cultural Database

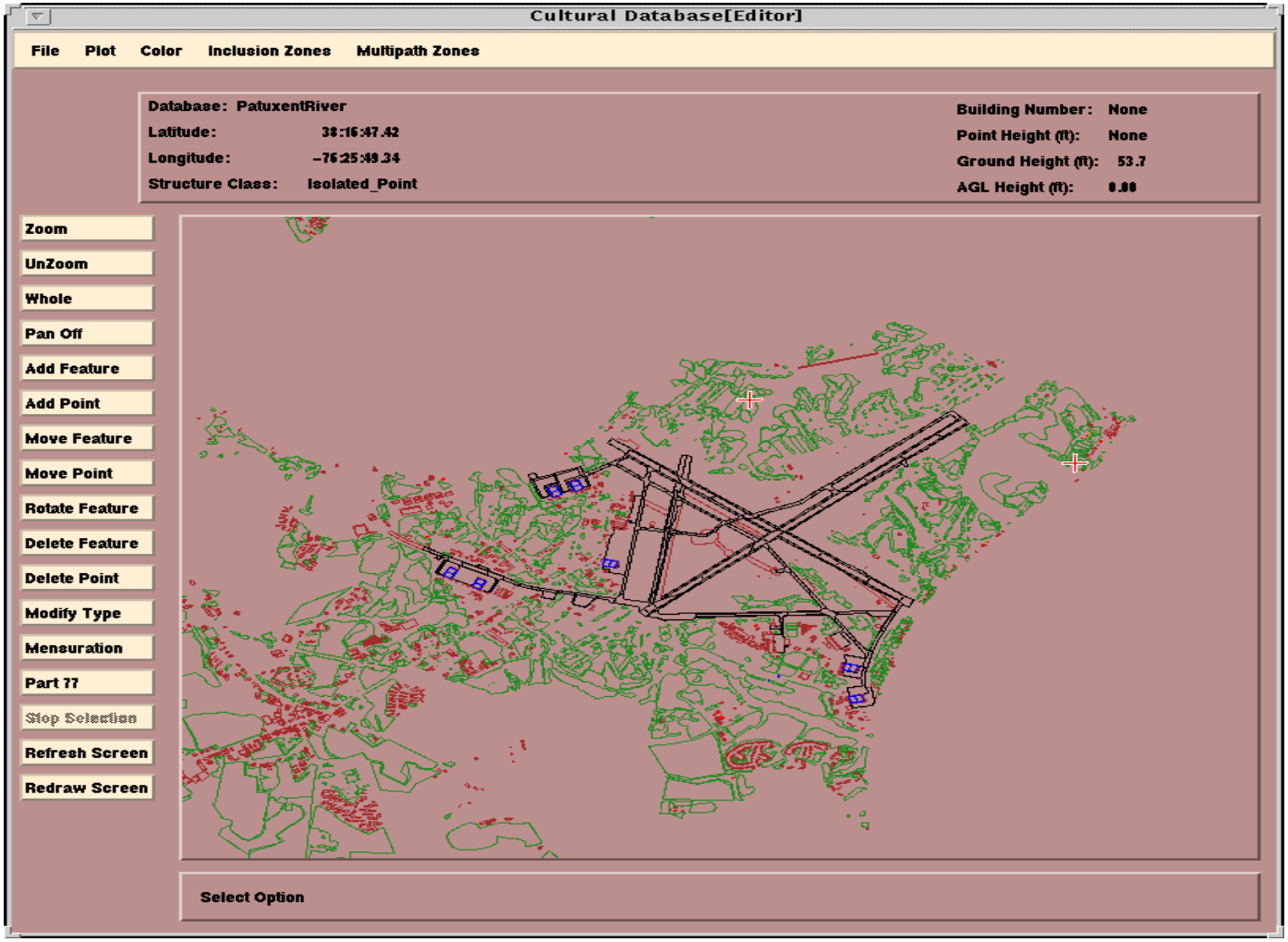


Technology Service Corporation

Photoviewer Display Of The Pax Airport Area

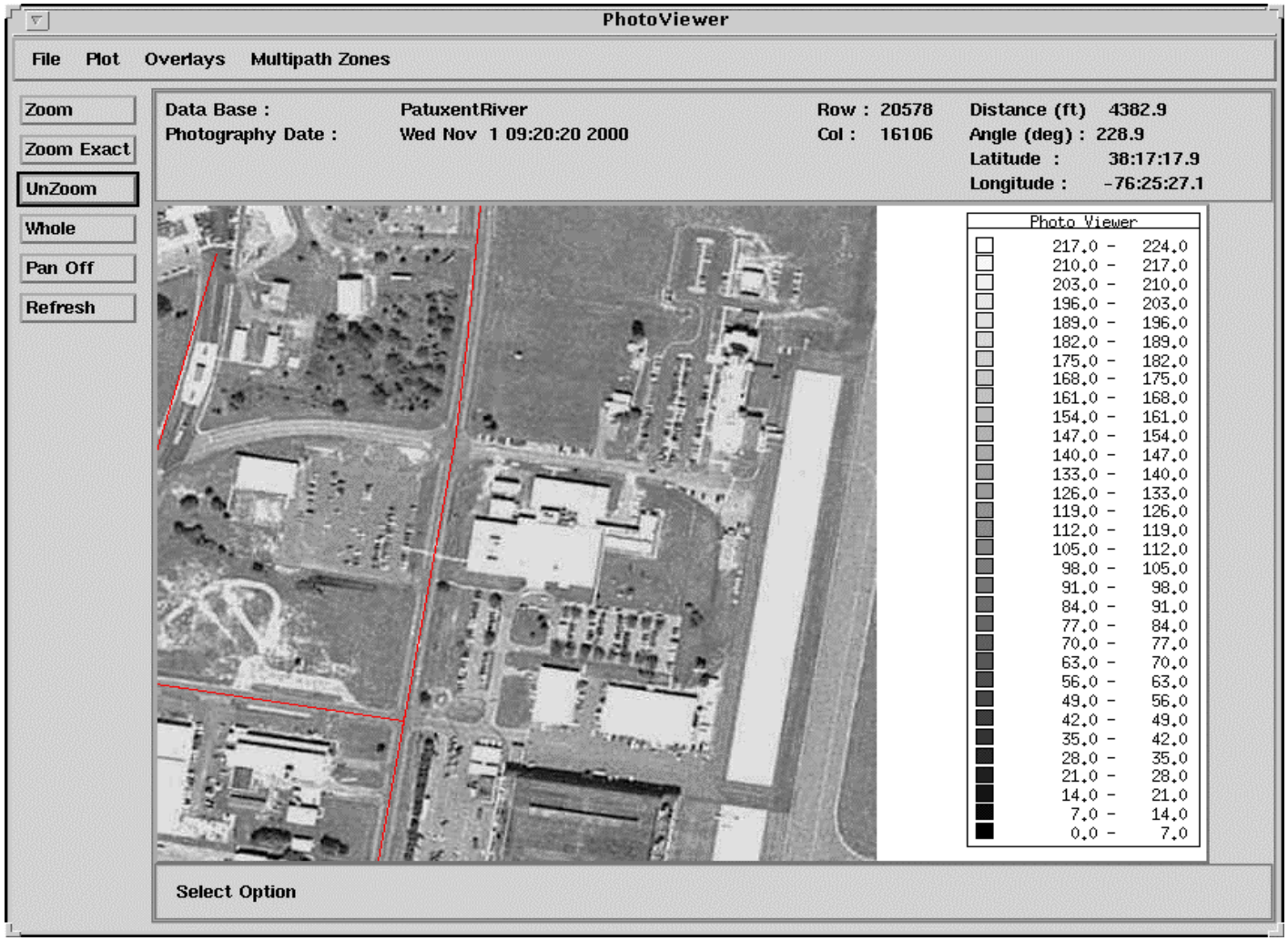
Technology Service Corporation

Cultural Database Of The Pax Airport Area



Technology Service Corporation

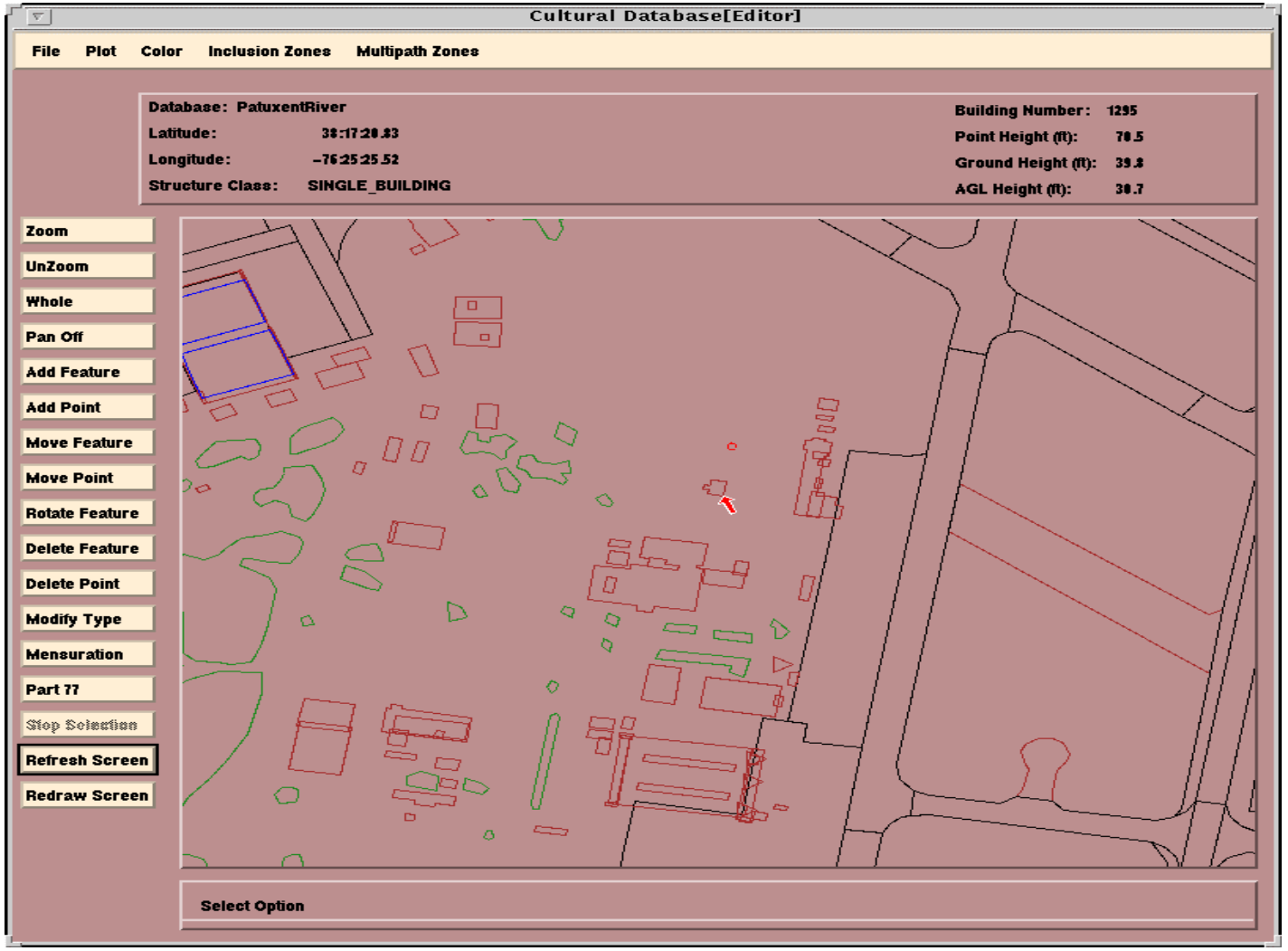
Photoviewer Display Of The Control Tower/Air Op's Area



Technology Service Corporation

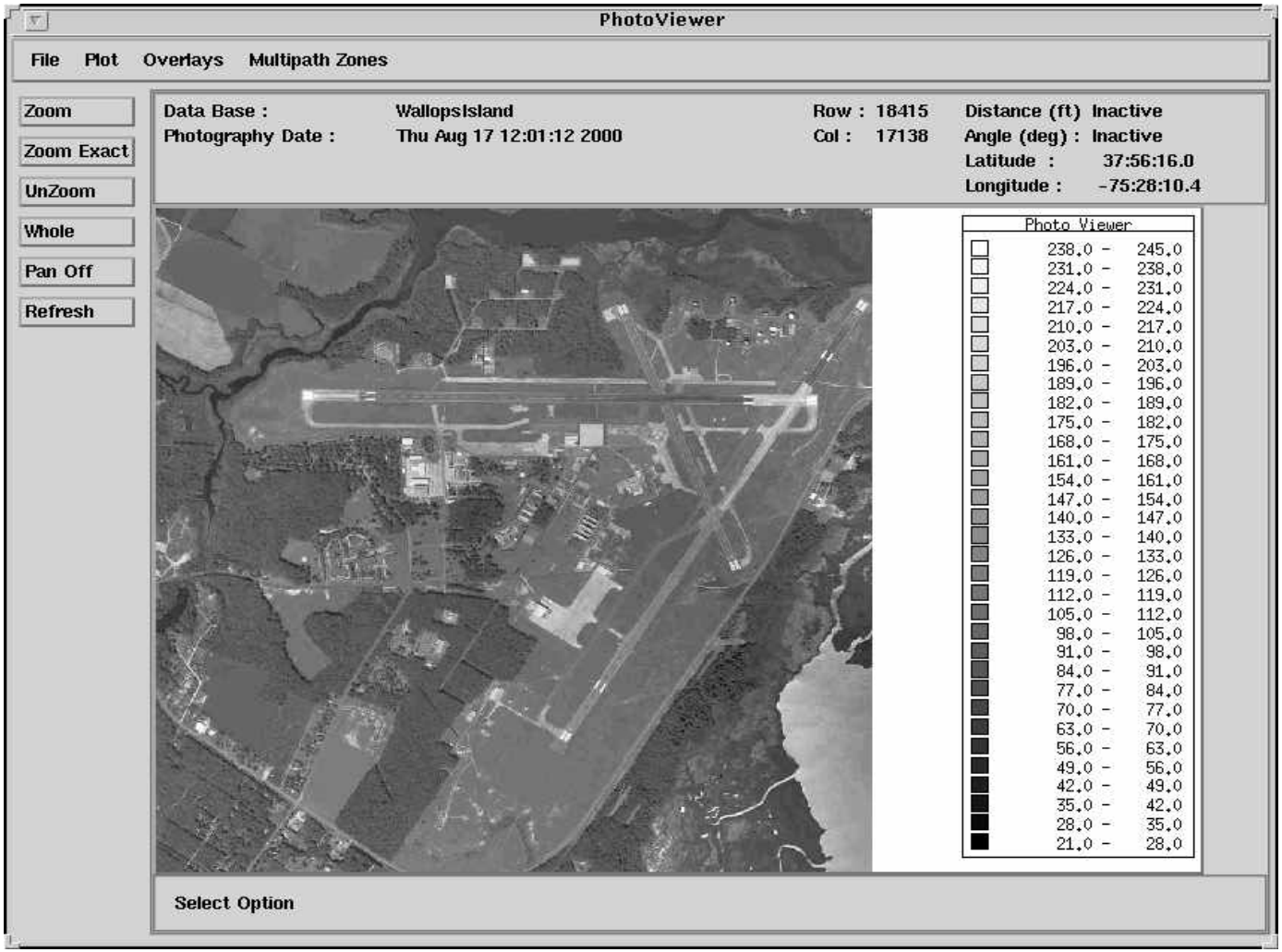
Cultural Database

Of The Control Tower/Air Op's Area



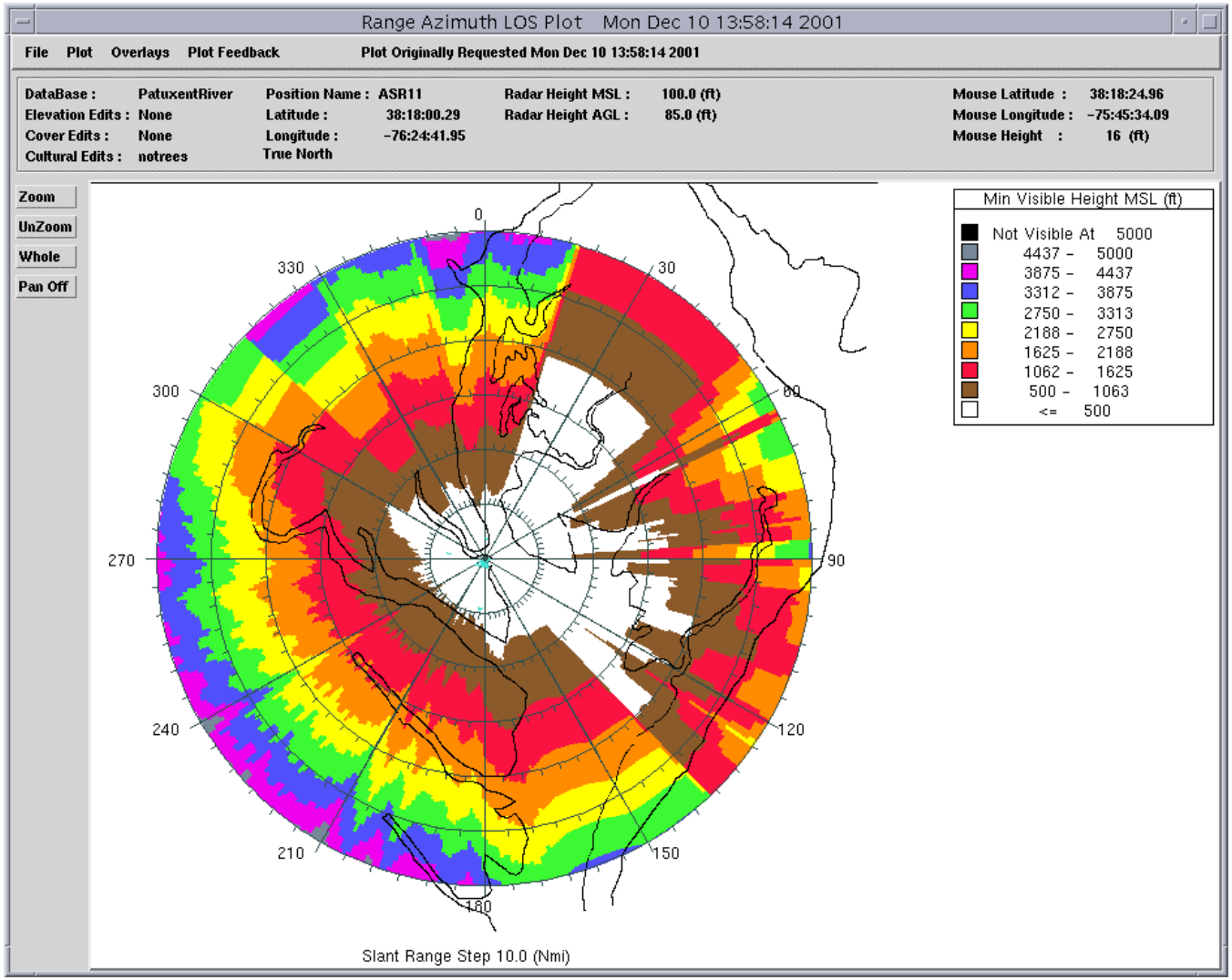
Technology Service Corporation

Photoviewer Display Of Wallops Airport Area



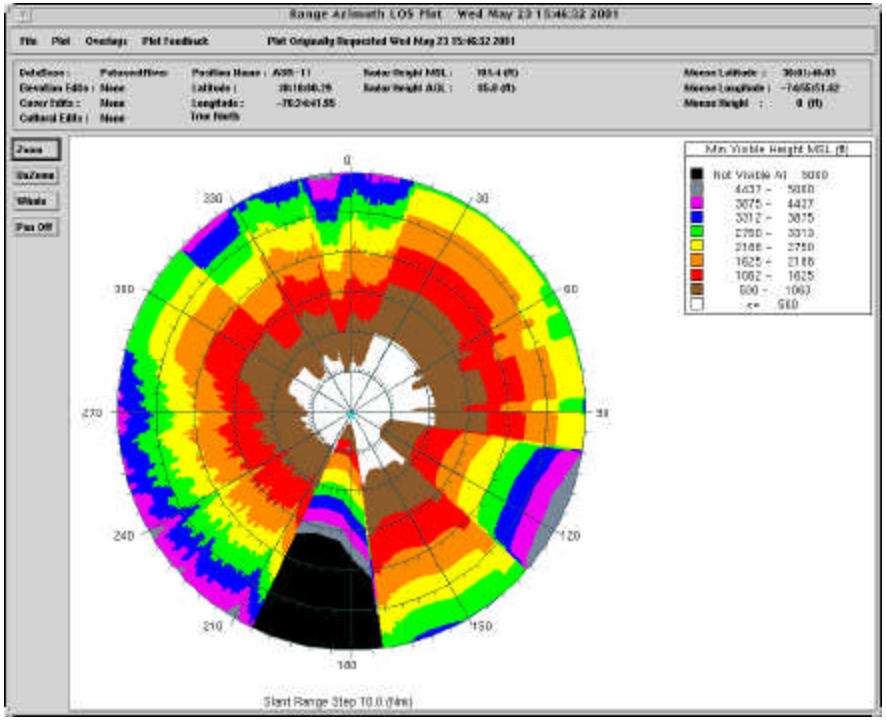
Technology Service Corporation

Line Of Sight (LOS) Plot
For ASR-11 At Proposed Pax Site

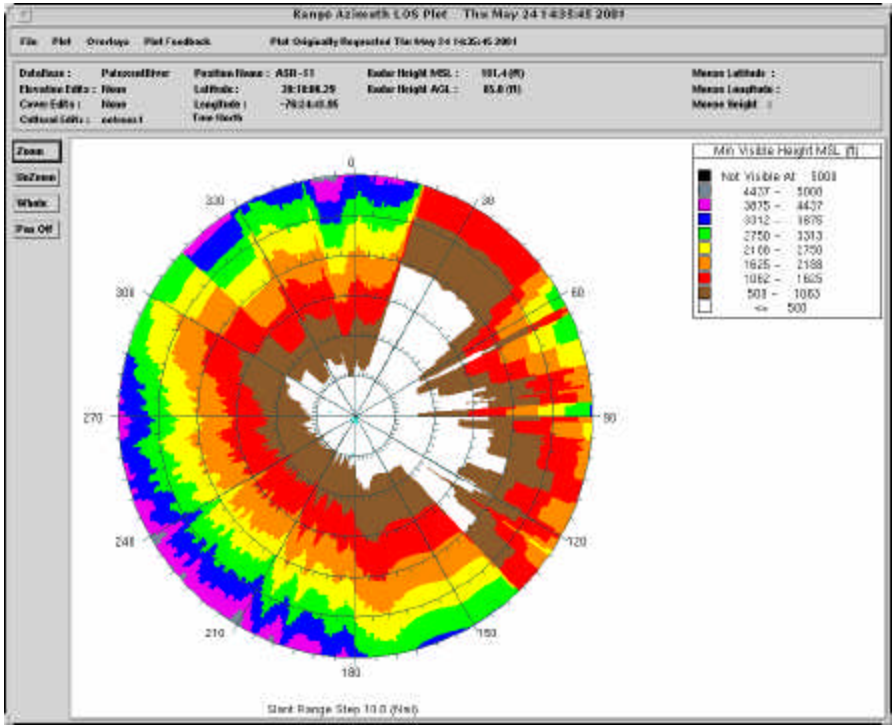


Technology Service Corporation

ASR-11 LOS Plots
Showing Effect Of Tree Removal



With existing trees

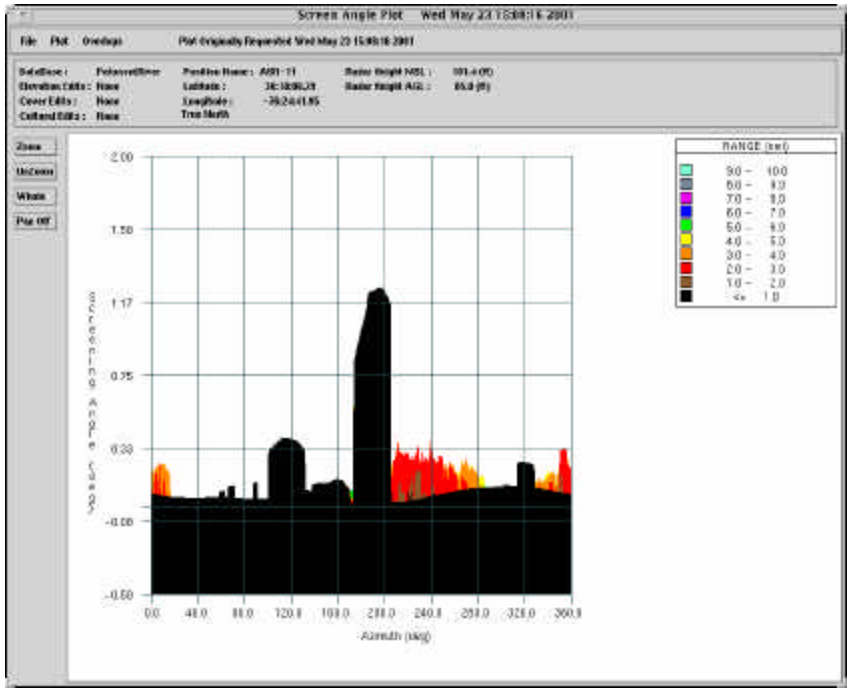


With trees removed 160’ X 160’ centered at radar plus selective clearing

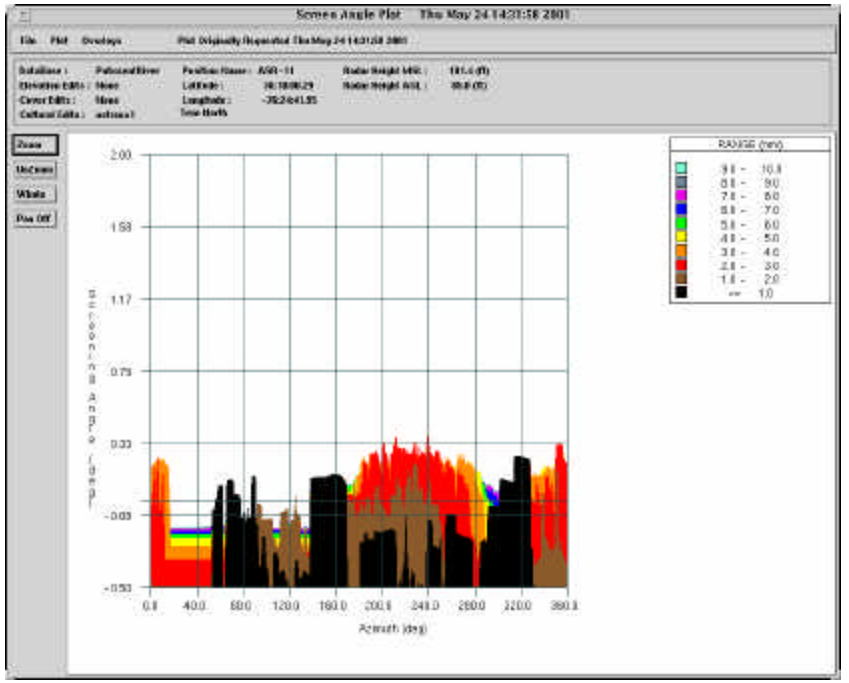
Tree removal eliminates blockages at 115 and 190 degrees azimuth and improves LOS coverage. Low altitude LOS visibility is also improved between 17 and 50 degrees.

Technology Service Corporation

ASR-11 screen angle plots showing effect of tree removal



With existing trees

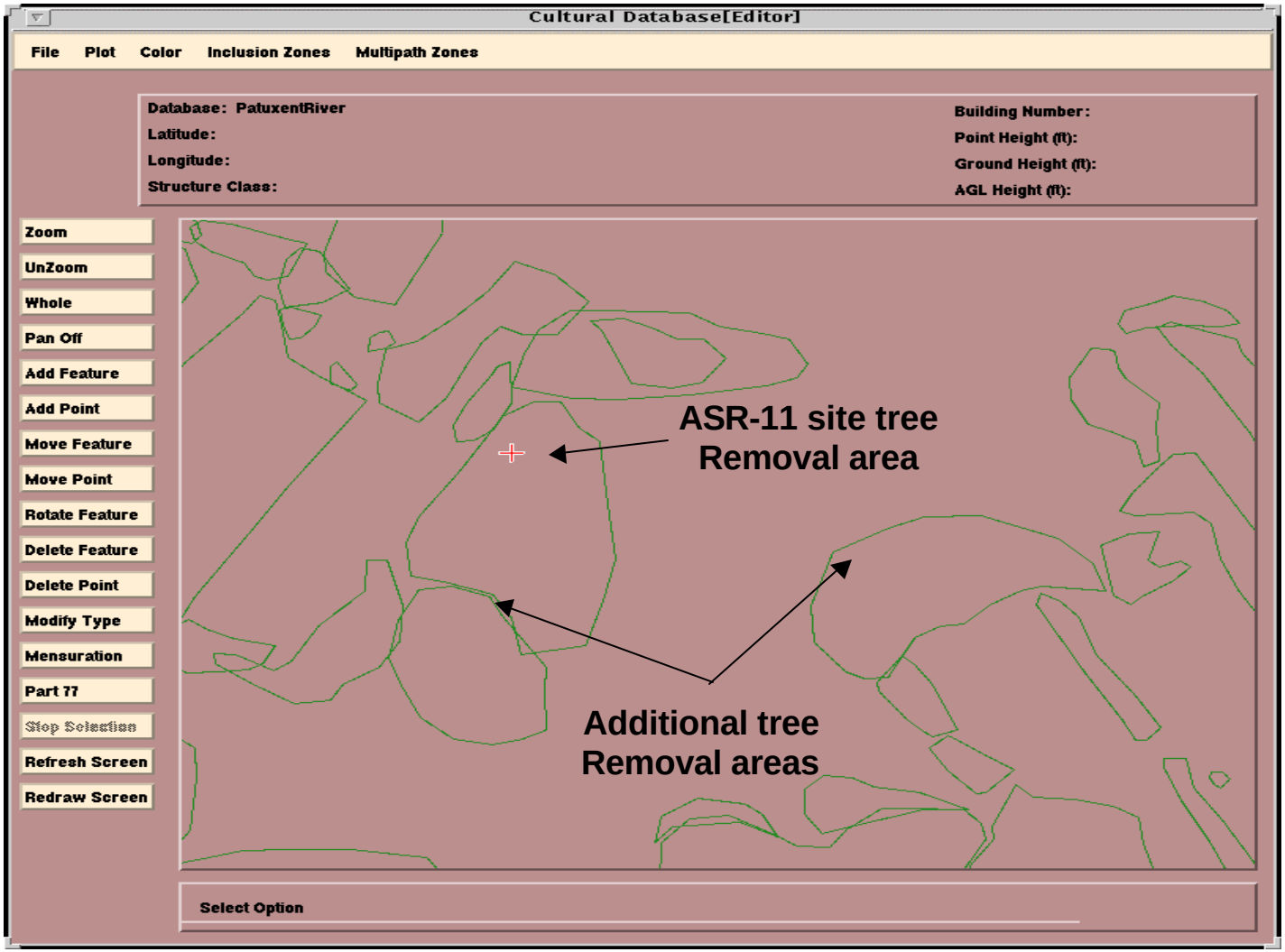


With trees removed 160’ X 160’ centered at radar plus selective clearing

Tree removal eliminates blockages at 115 and 190 degrees azimuth and improves LOS coverage. Low altitude LOS visibility is also improved between 17 and 50 degrees.

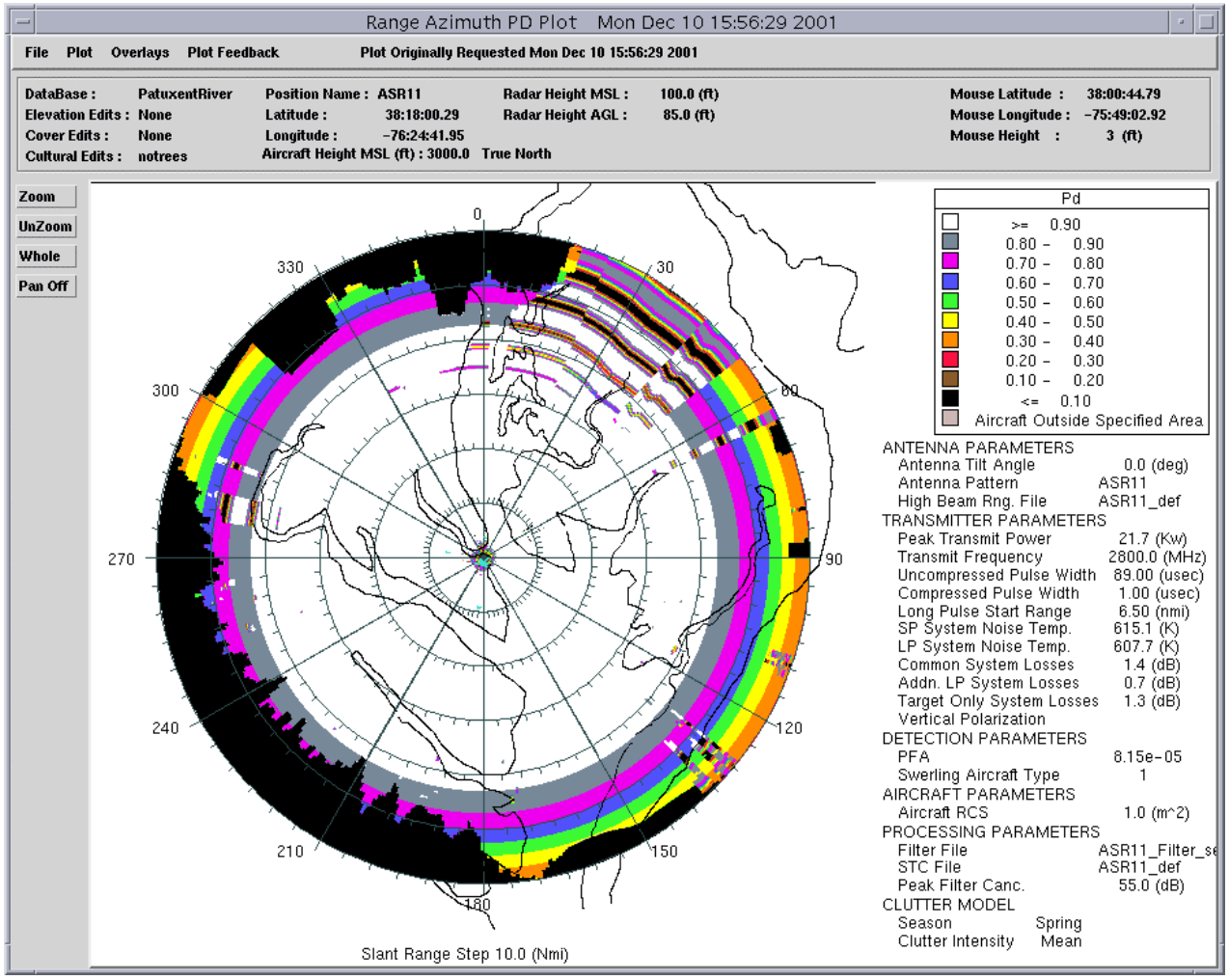
Technology Service Corporation

Cultural Database For ASR-11 Area Showing Heavy Tree Cover



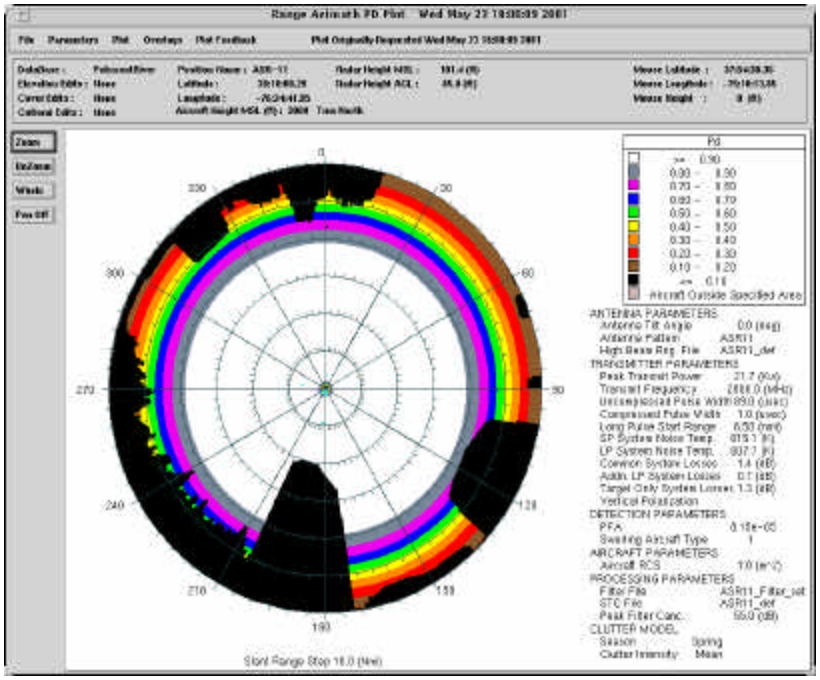
Technology Service Corporation

ASR-11 Probability Of Detection (Pd) Plot For A/C Height 3000’ Above MSL @ Sea State Zero

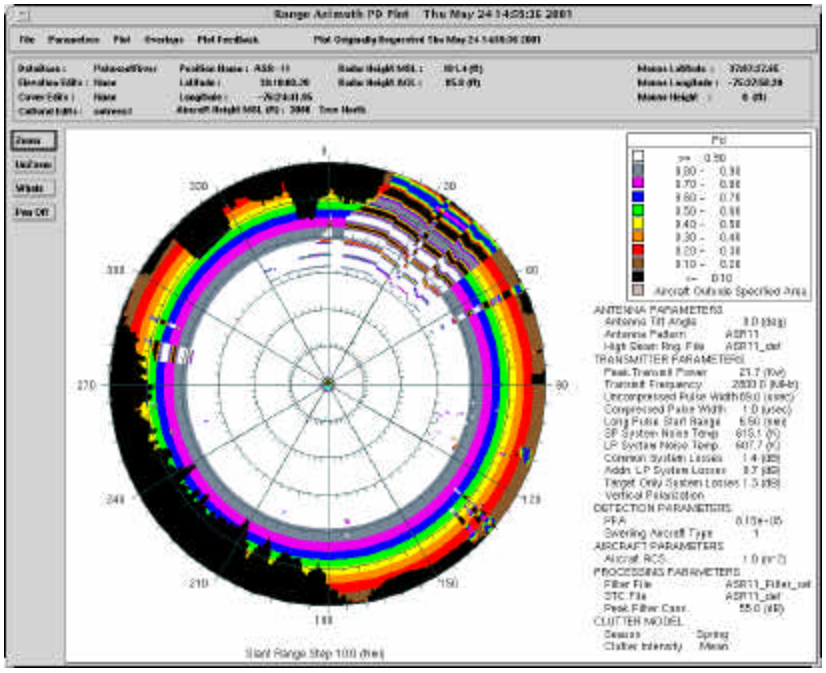


Technology Service Corporation

ASR-11 range azimuth Pd plots for A/C height 3000’ above MSL @ sea state zero



With existing trees

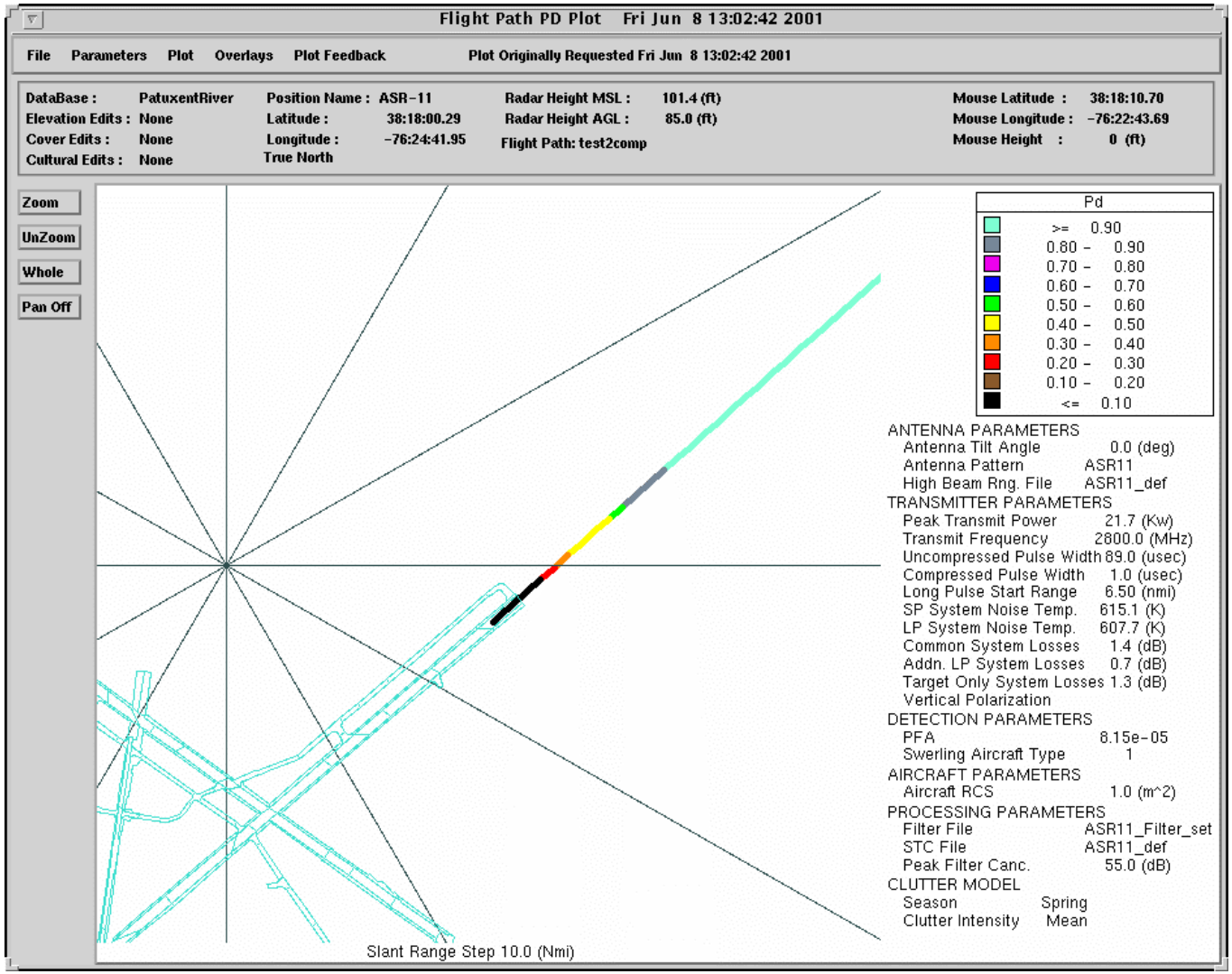


With trees removed 160’ X 160’ centered at radar plus selective clearing

Tree removal eliminates blockages at 115 and 190 degrees azimuth and improves LOS coverage. Low altitude LOS visibility is also improved between 17 and 50 degrees.

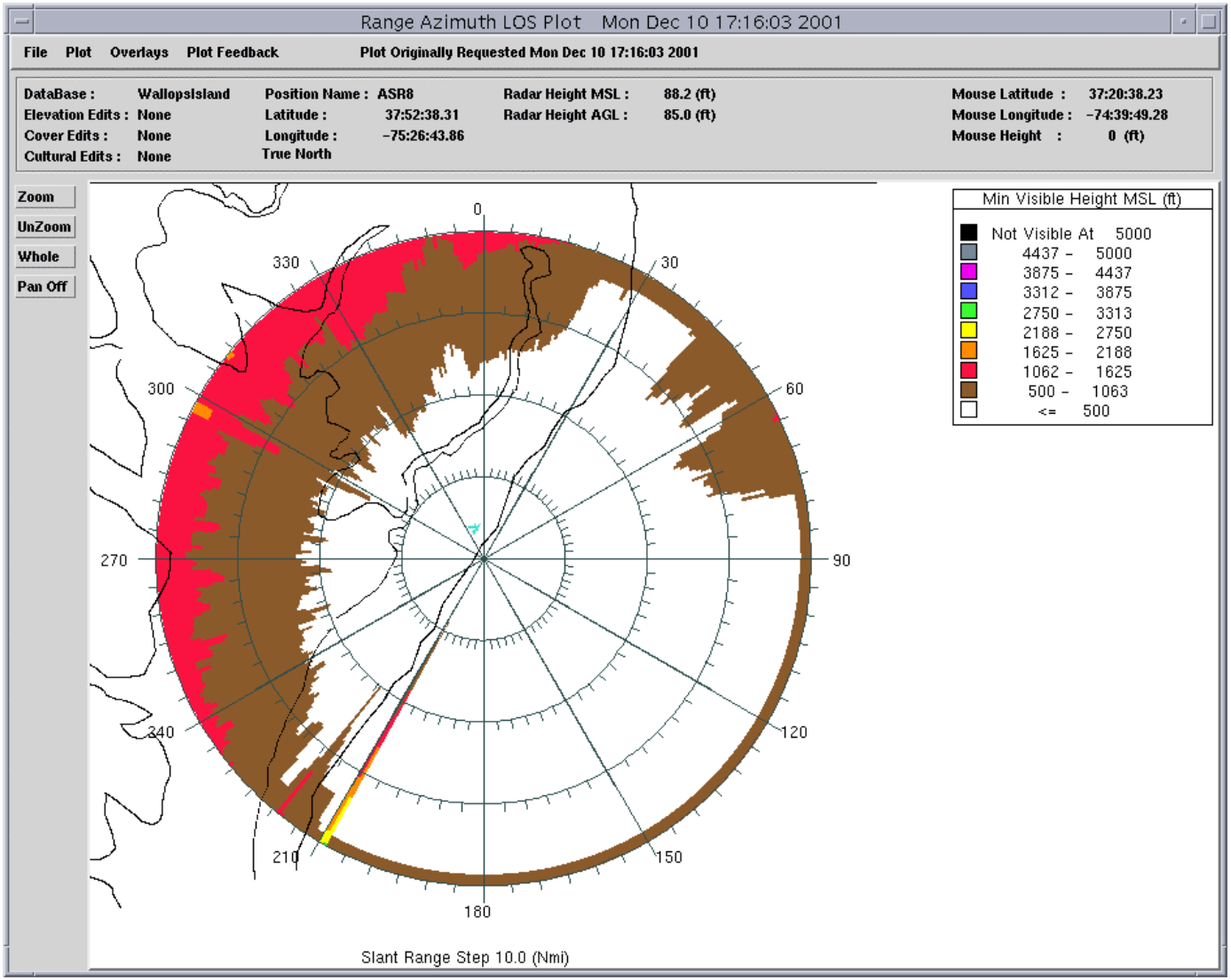
Technology Service Corporation

ASR-11 Pd Analysis
For Specified Flight Path



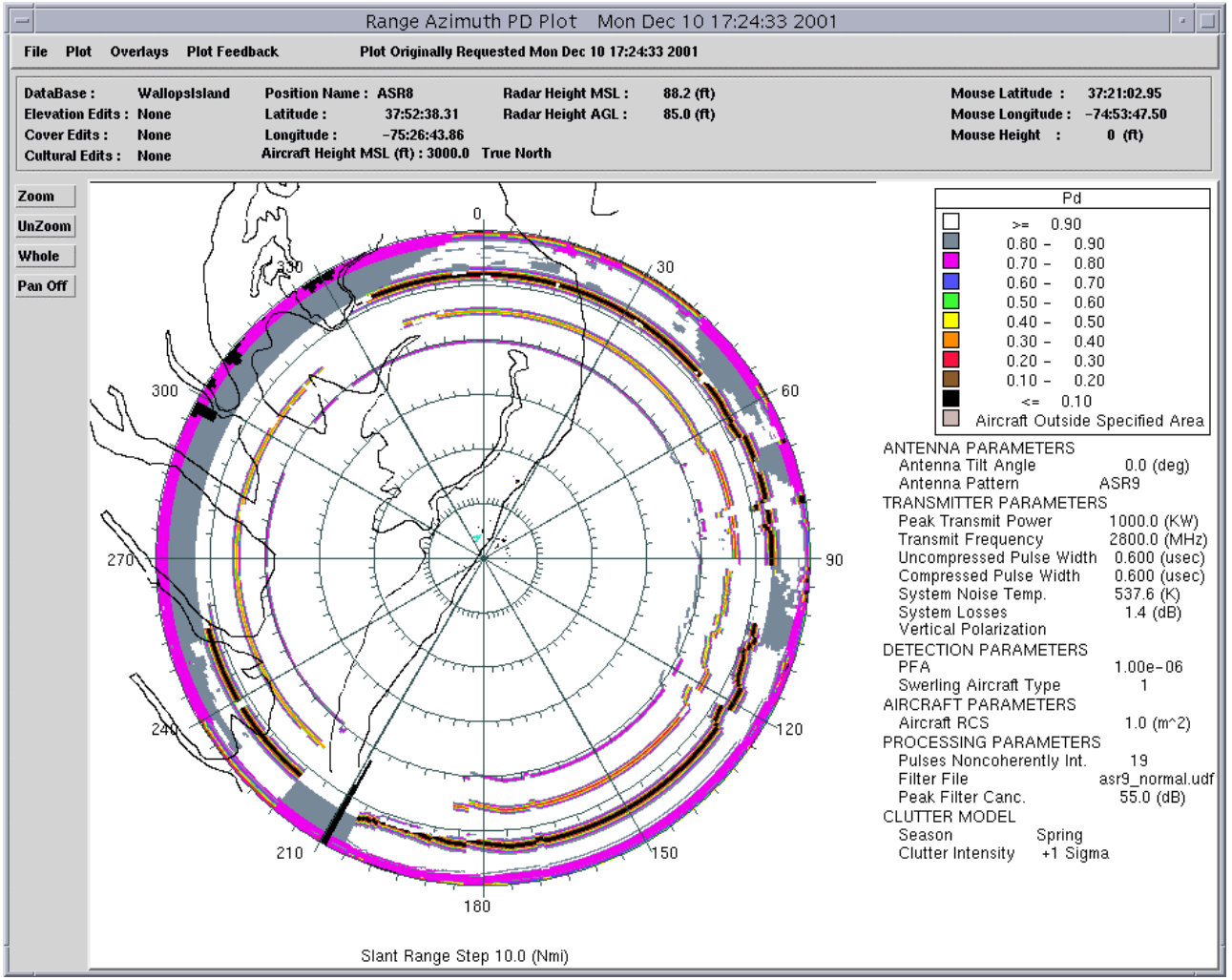
Technology Service Corporation

LOS Plot For ASR-8 At Wallops Site



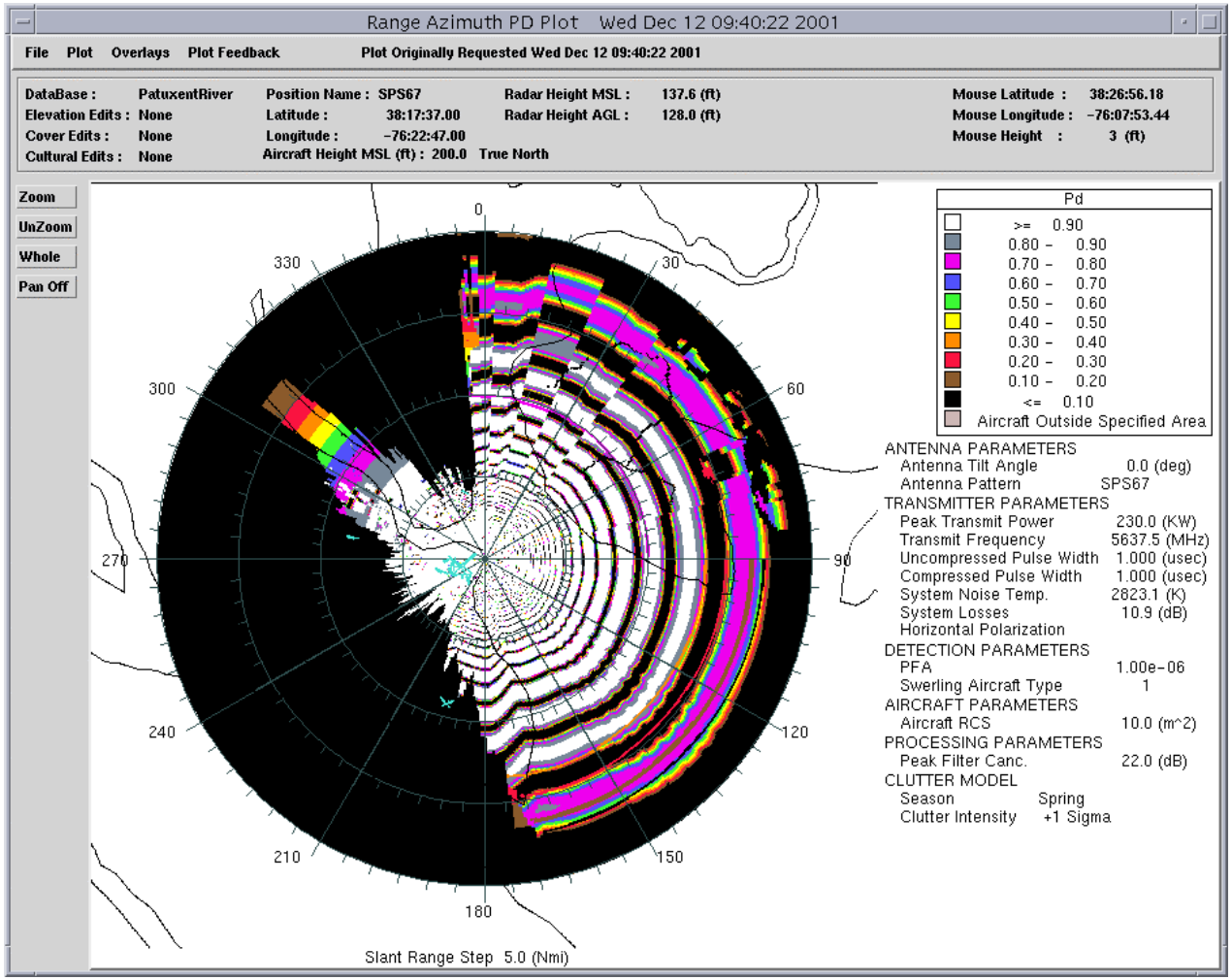
Technology Service Corporation

ASR-8 Range Azimuth Pd Plots For A/C Height 3000’ Above MSL @ Sea State Zero



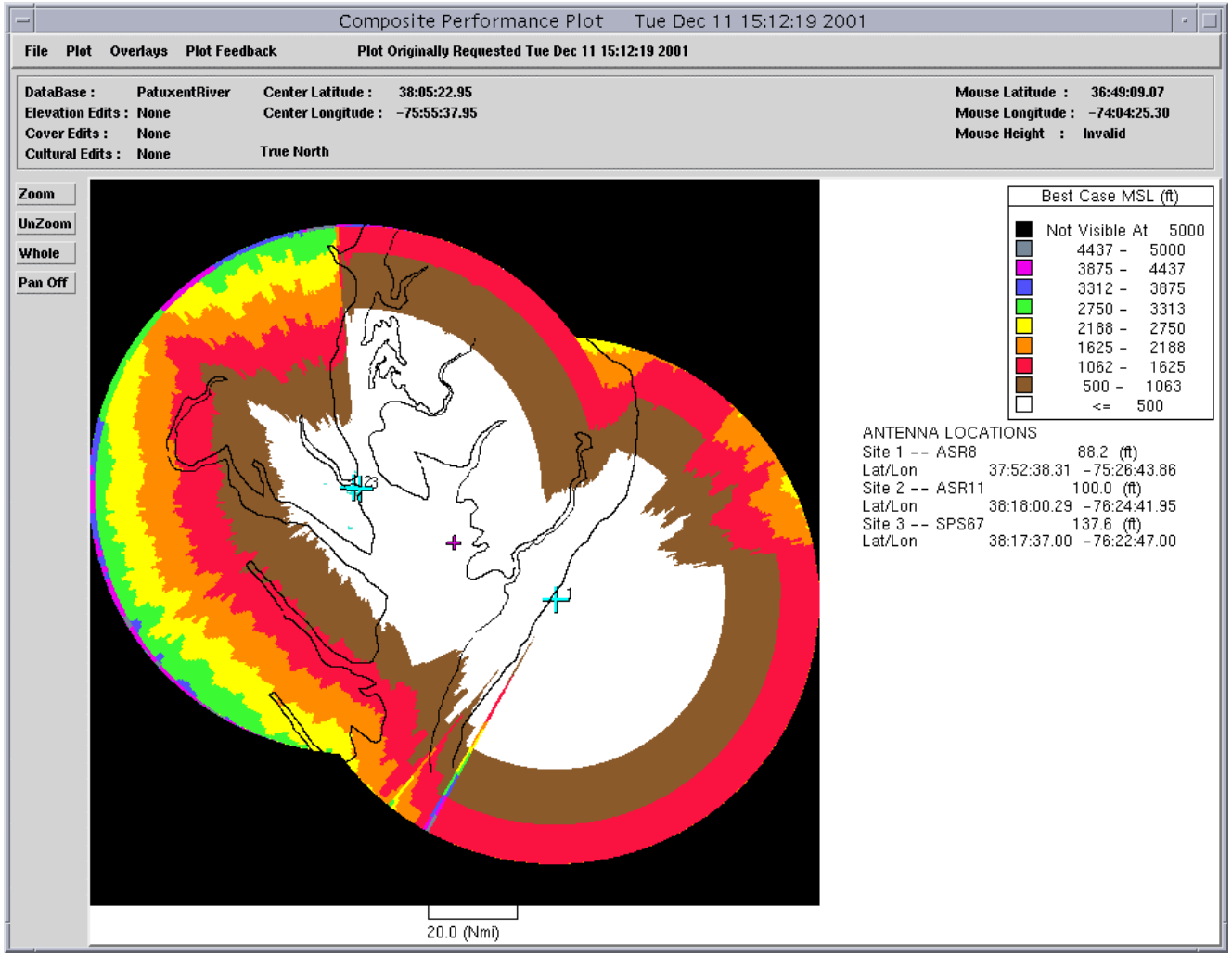
Technology Service Corporation

SPS-67 Range Azimuth Pd Plots For A/C Height 200’ Above MSL For Target RCS 10 Sq. M.



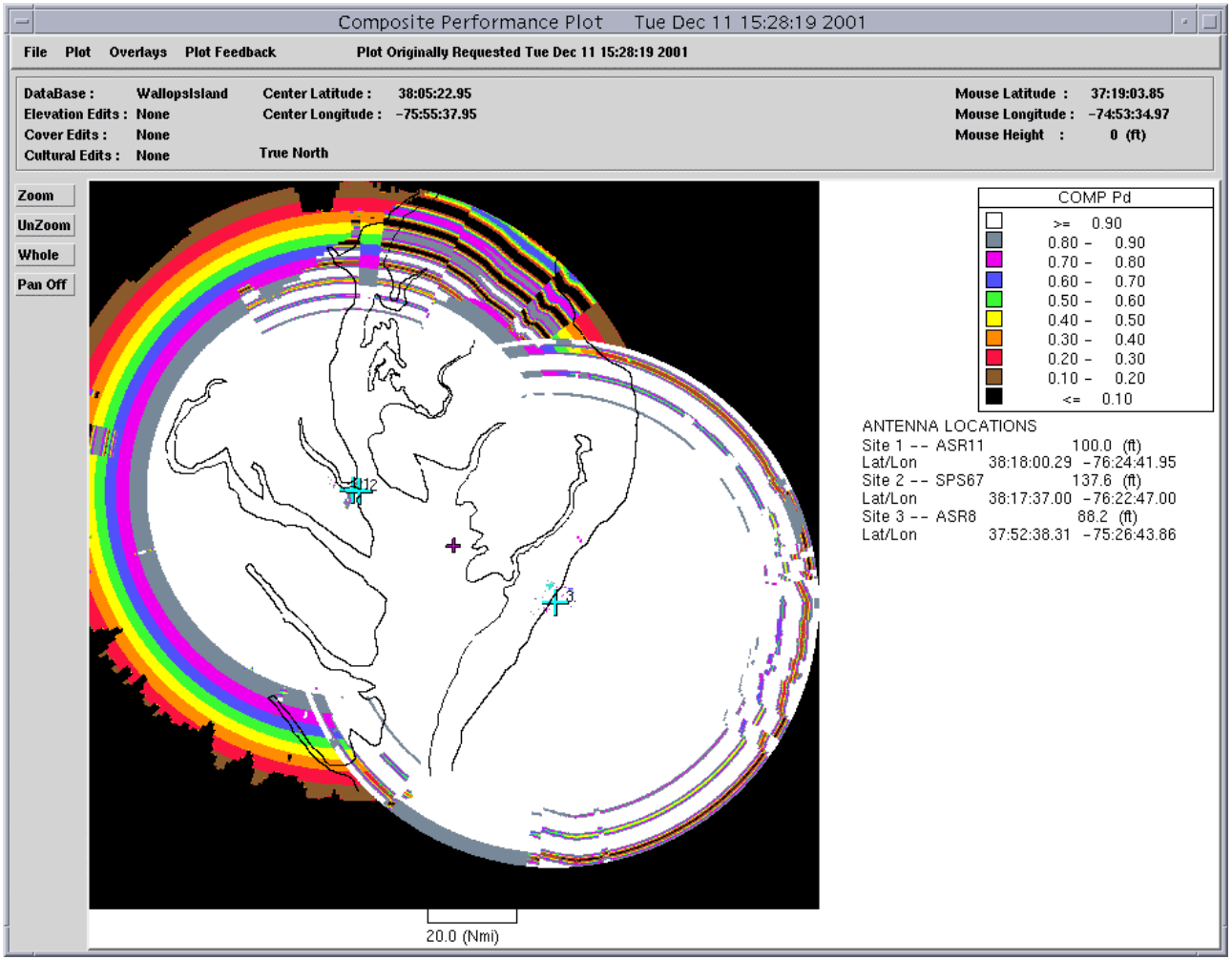
Technology Service Corporation

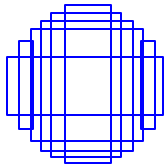
Mosaic LOS Plot Showing Composite Coverage For The ASR-11 & SPS-67 At Pax, ASR-8 At Wallops



Technology Service Corporation

Mosaic Pd Plot For The ASR-11, ASR-8 And SPS-67 For A/C Height 5000’ Above MSL





Technology Service Corporation

Other Surveillance Sensor Siting and Coverage Examples

Technology Service Corporation

Beacon False Target "What If" Analysis

(What is the effect of proposed construction?)

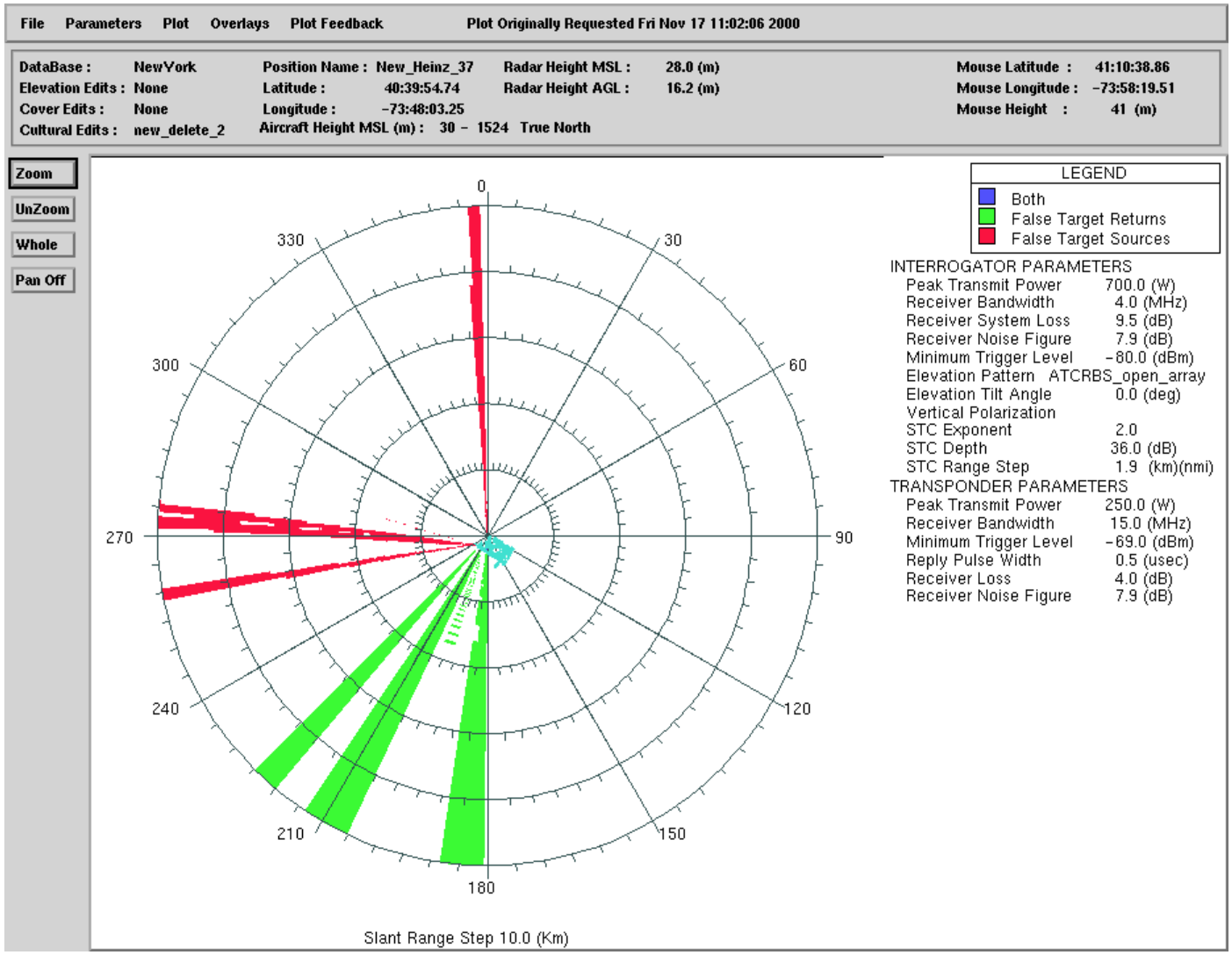
- False target sources and returns are shown for a baseline configuration
- A new proposed building is then edited into the cultural database
- Analysis reveals increased false targets in critical areas caused by the building
- The building is then rotated by 25 degrees
- False targets are reduced to acceptable levels

Similar "what if" analyses can evaluate effect of building shape, surface material, and location

Technology Service Corporation

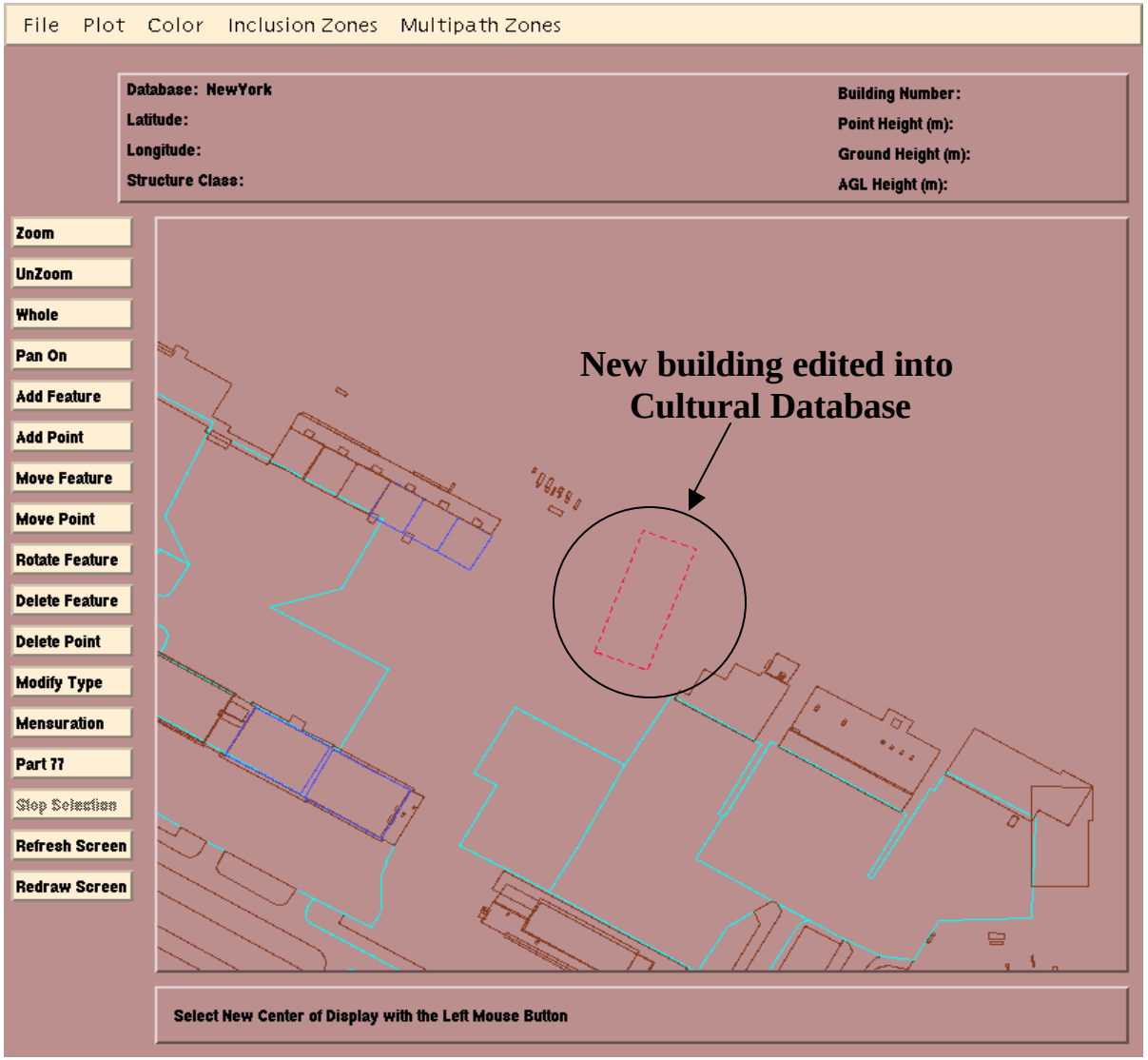
Beacon False Target (BFT) Plot

Before Construction



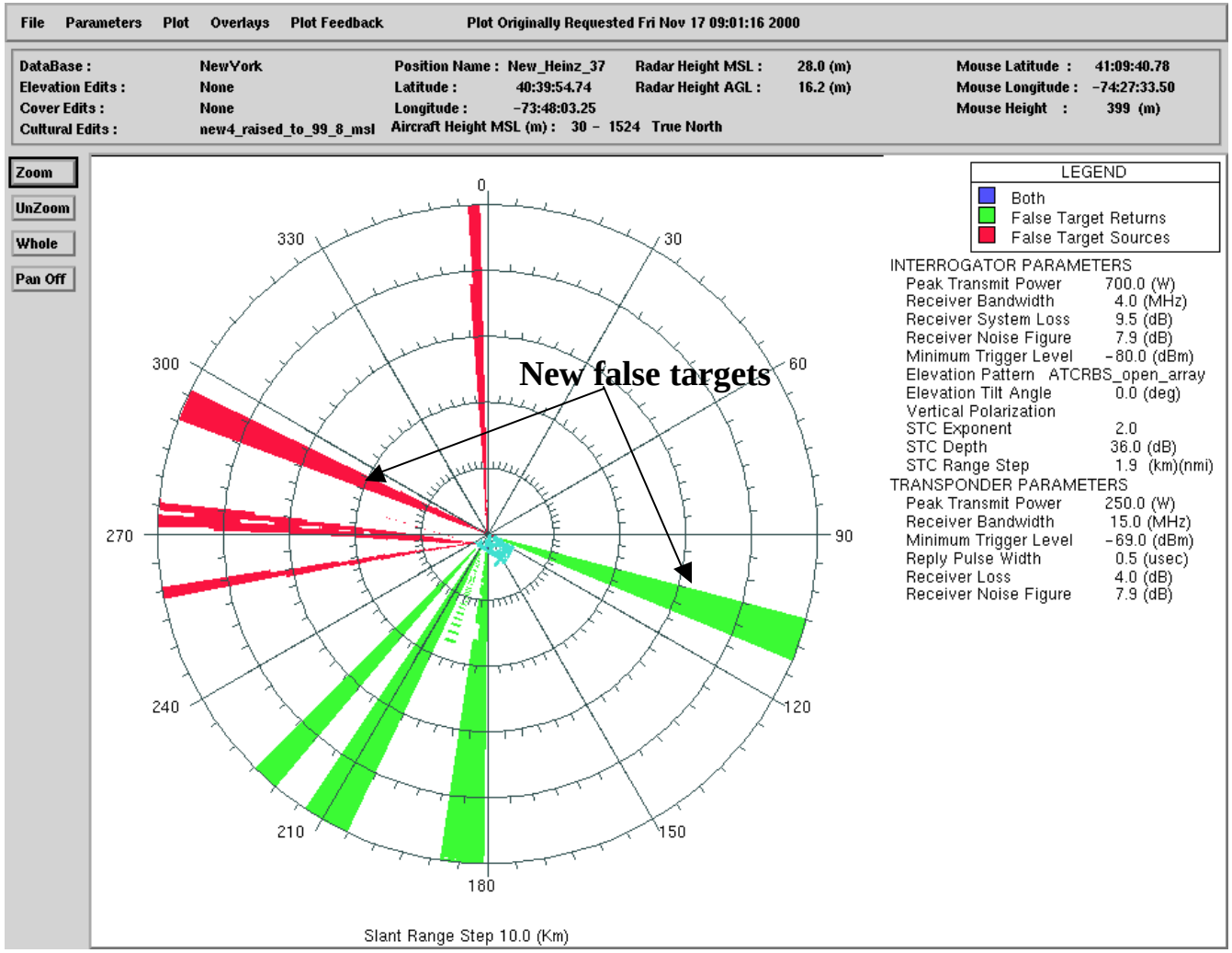
Technology Service Corporation

Zoomed Cultural Database Showing Proposed New Building



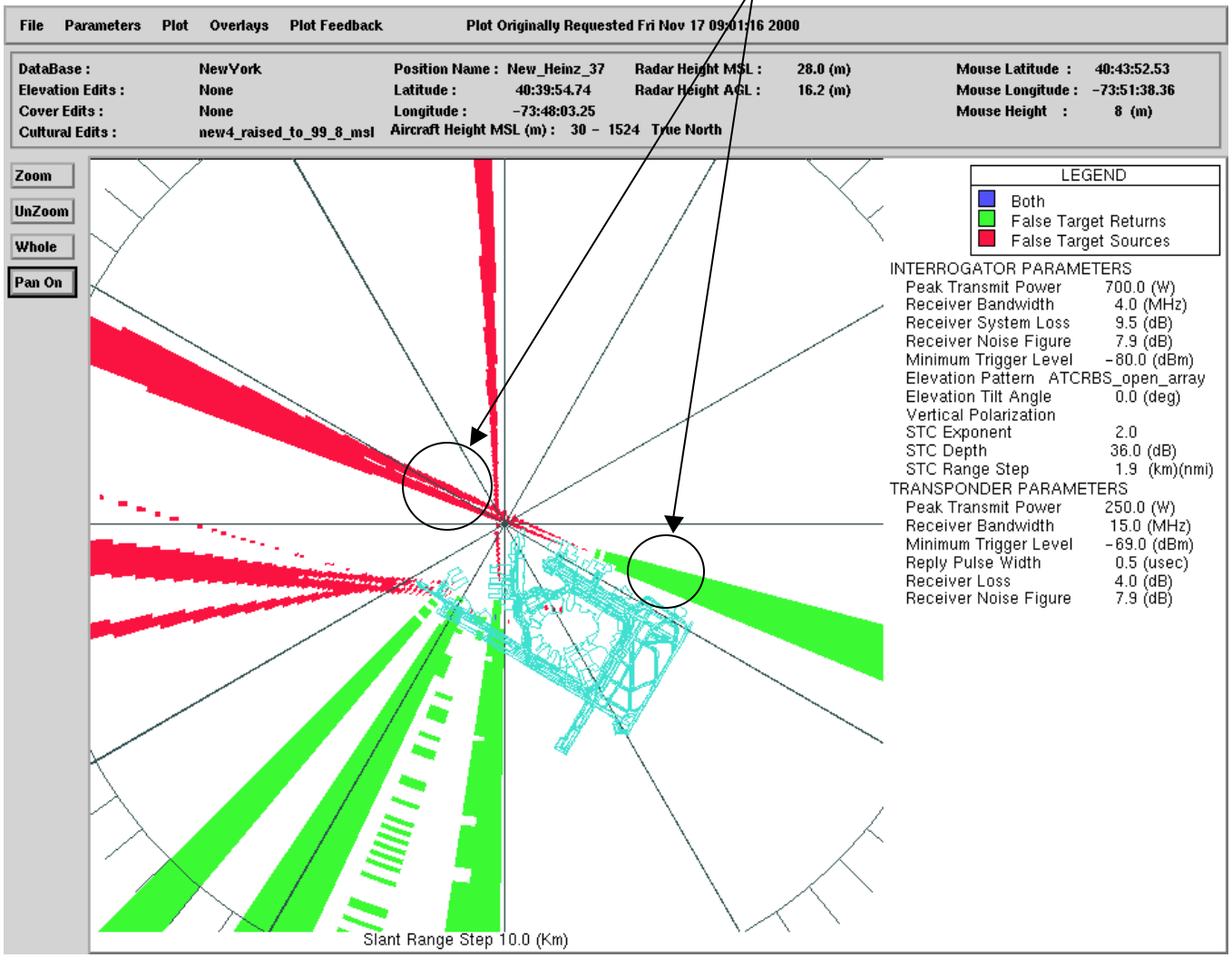
Technology Service Corporation

Beacon False Target Plot With Proposed New Building



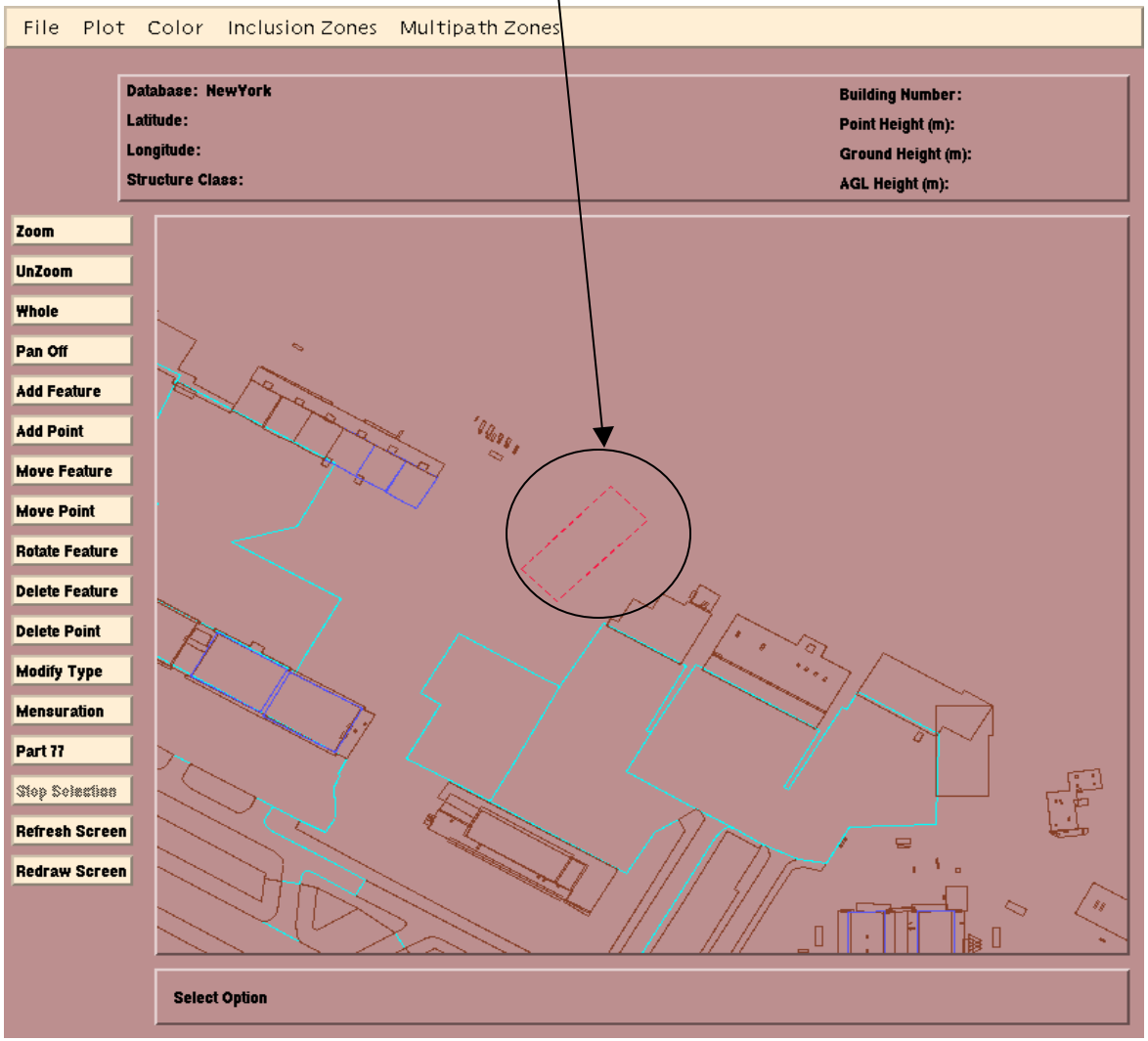
Technology Service Corporation

Zoomed BFT Plot Showing Critical Areas Affected By False Targets



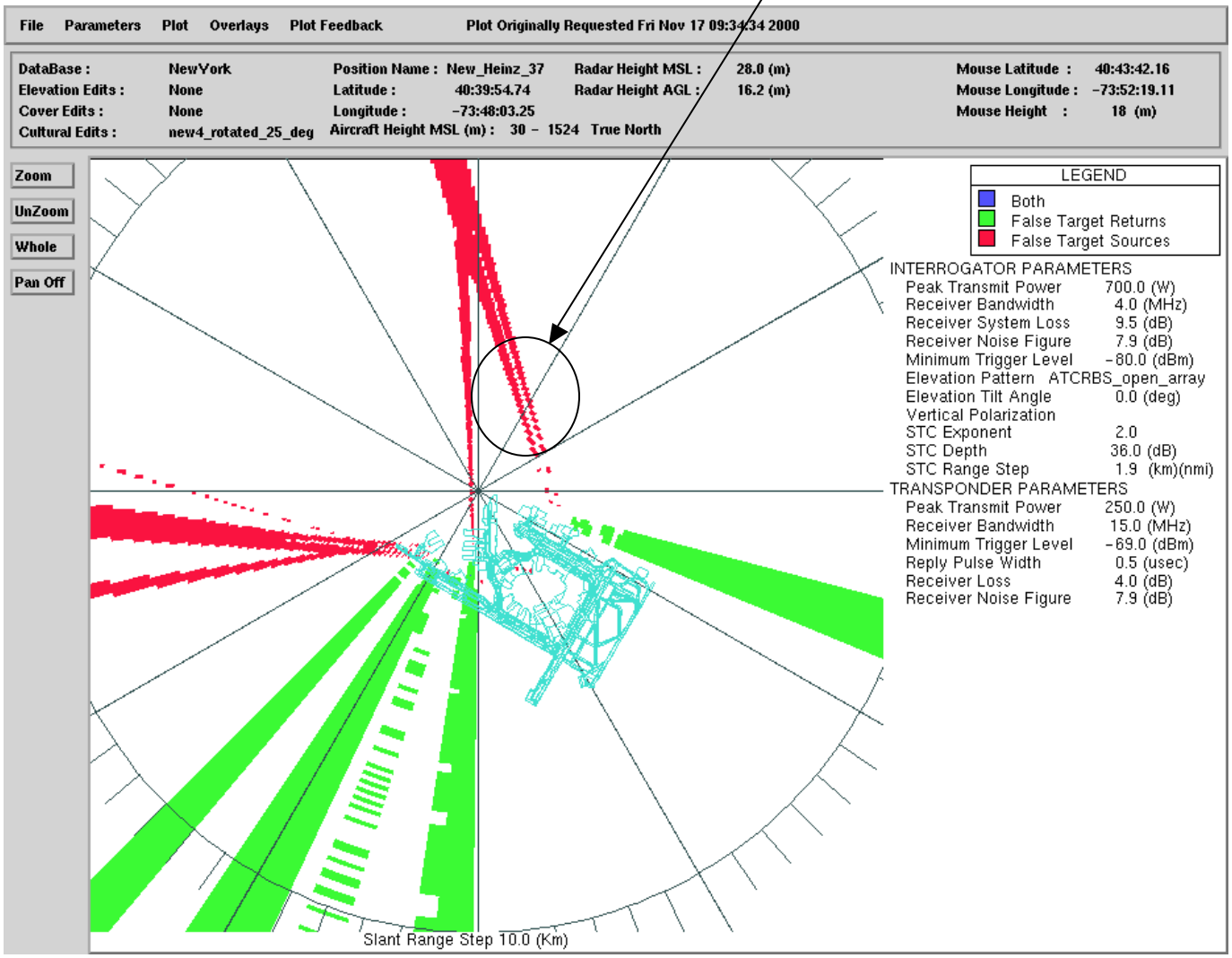
Technology Service Corporation

New Building Rotated by 25 Degrees in Cultural Database



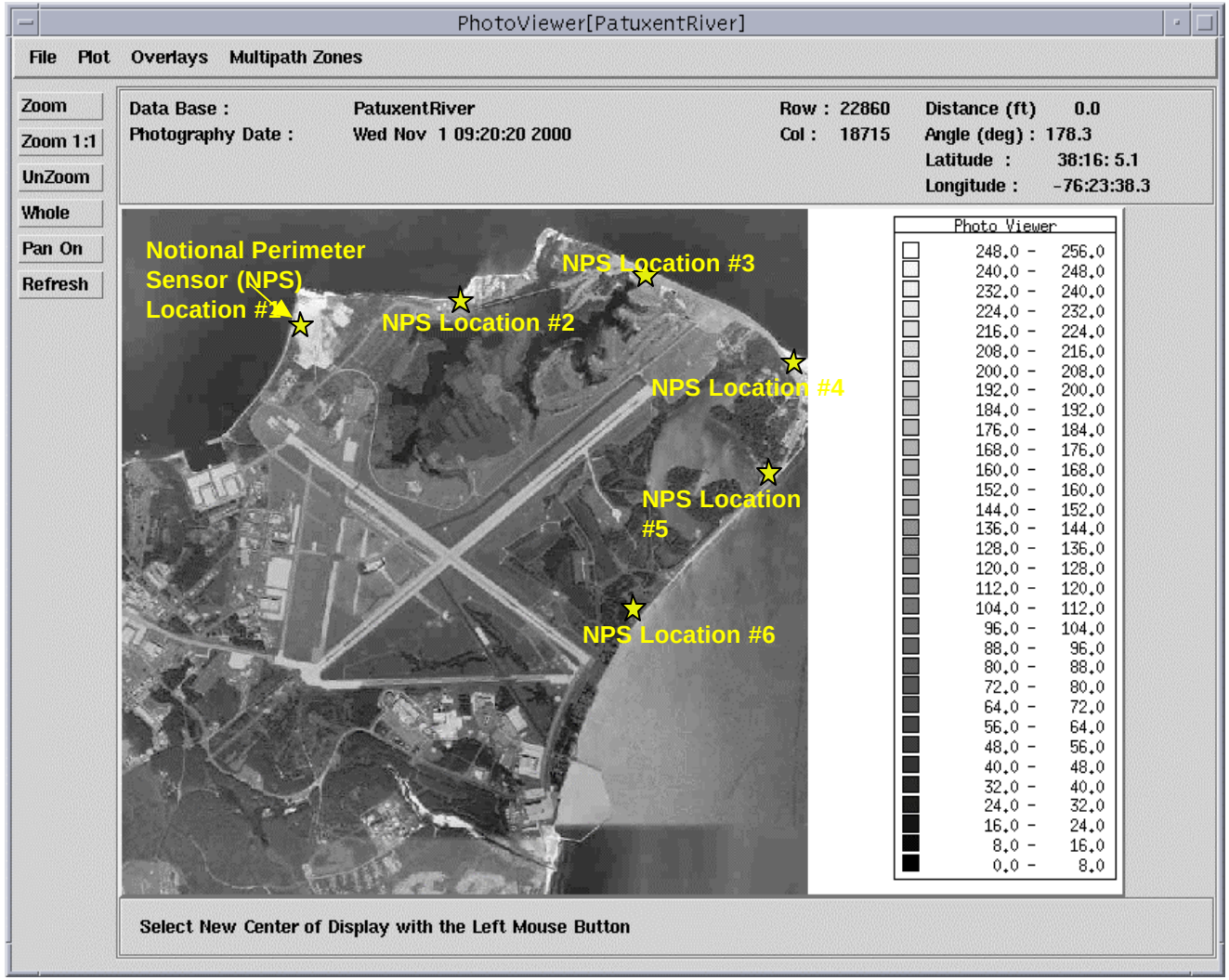
Technology Service Corporation

Zoomed BFT Plot Showing False Target Sources Shifted to Less Critical Area



Technology Service Corporation

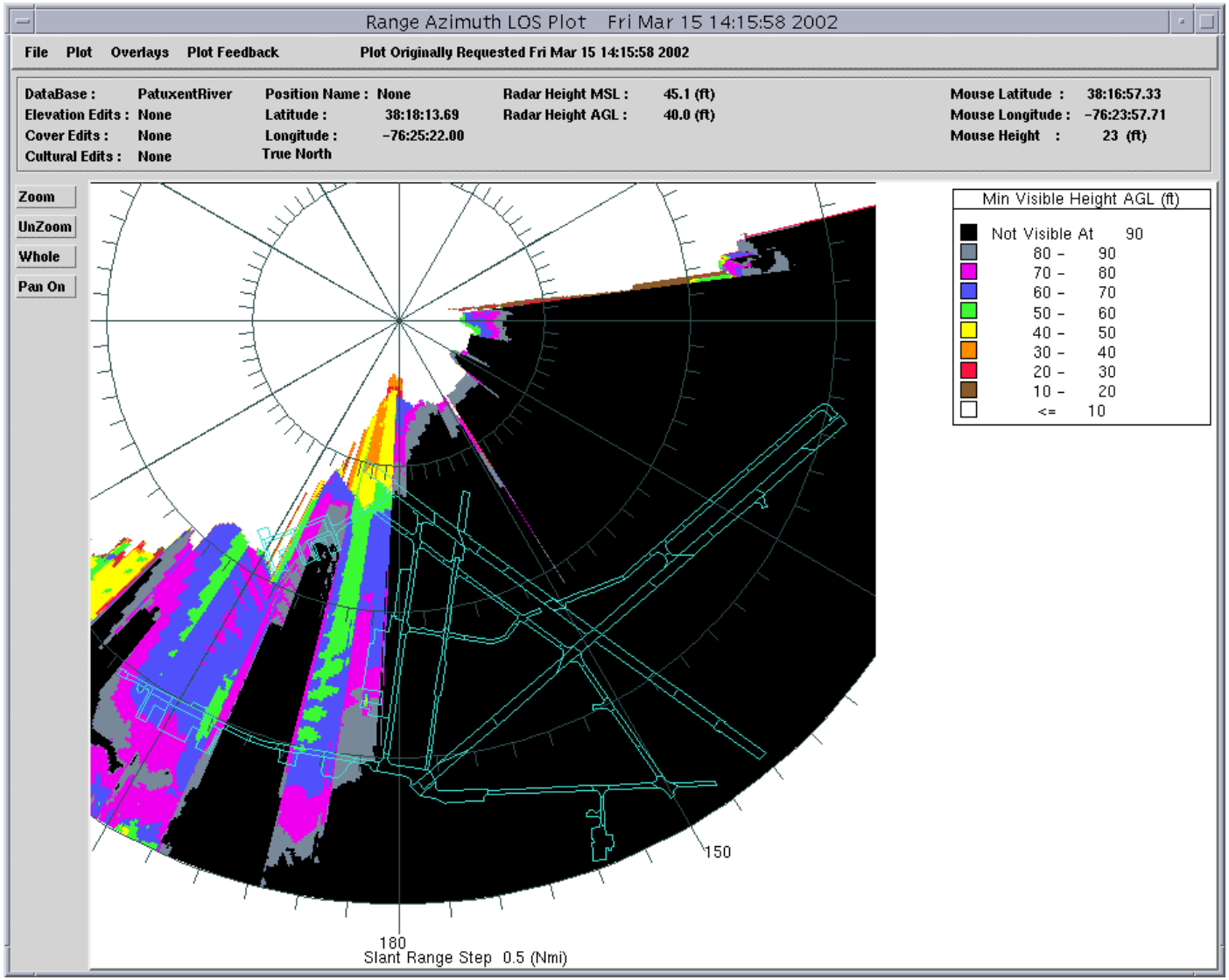
Surveillance Sensor Coverage Analysis For Perimeter Security



Notional perimeter sensors (NPS) evaluated at six hypothetical sites

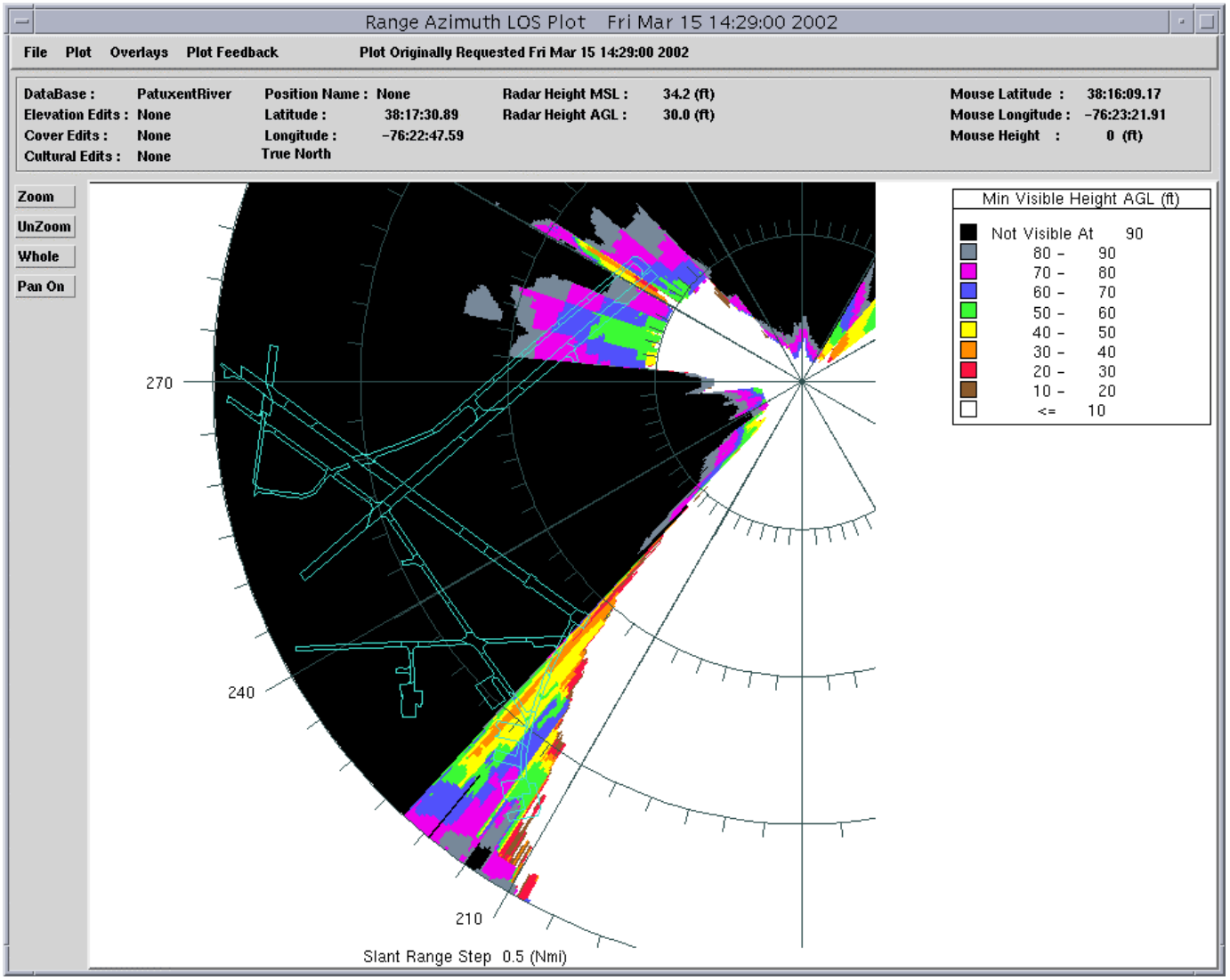
Technology Service Corporation

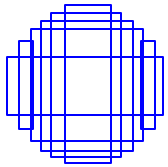
NPS # 1 Line-of-Sight Coverage



Technology Service Corporation

NPS # 5 Line-of-Sight Coverage





Technology Service Corporation

Summary

- The RSS provides a fast and accurate method for analysis of sensor coverage and performance
- Analysis results are presented in multicolor plots:
  - Line of sight
  - Screen angle
  - Probability of detection (Pd)
  - Specified flight path Pd
  - Beacon false targets
  - Various other customized plots
- The RSS applies to all surveillance sensors – ATM, ADS, perimeter security, harbor, artillery fire control, …

The RSS runs on a notebook PC under the Solaris OS